UNIVERSITY OF KERALA

B. TECH. DEGREE COURSE

(2013 SCHEME)

SYLLABUS FOR

VII SEMESTER

MECHANICAL ENGINEERING

SCHEME -2013

VII SEMESTER
MECHANICAL ENGINEERING (M)

Course No	Name of subject	Credits	Weekly load, hours			C A Marks	Exam Duration Hrs	U E Max Marks	Total Marks
			L	T	D/ P				
13.701	Principles of Management and Decision Modeling (MPU)	3	2	1	-	50	3	100	150
13.702	Mechatronics (MPSU)	4	3	1	-	50	3	100	150
13.703	Gas Dynamics (M)	4	3	1	-	50	3	100	150
13.704	Refrigeration & Air conditioning (M)	4	3	1	-	50	3	100	150
13.705	Design of Machine Elements - II (M)	4	3	1	-	50	3	100	150
13.706	Elective III	4	3	1	-	50	3	100	150
13.707	Thermal Engineering Lab (M)	2	-	-	2	50	3	100	150
13.708	Mechanical Engineering Lab (M)	2	-	-	2	50	3	100	150
13.709	Project and Project Seminar (MNPSU)	2	-	-	2	100	-		100
	Total	**29**	**17**	**6**	**6**	**500**		**800**	**1300**

13.706 Elective III

13.706.1	Plant Engineering & Maintenance (MPU)
13.706.2	Fracture Mechanics (MPU)
13.706.3	Entrepreneurship Development (MPU)
13.706.4	Finite Element Methods (MPU)
13.706.5	Metal Forming (MPU)
13.706.6	Non-Conventional Machining Techniques (MPU)
13.706.7	Experimental Methods In Engineering (MPU)
13.706.8	Mechanical Vibration & Noise Control (MPU)
13.706.9	Failure Analysis (MPU)
13.706.10	Industrial Automation (MPU)
13.706.11	Advanced Thermodynamics (MP)
13.706.12	Industrial Heat Transfer (MP)
13.706.13	Computer Graphics (MP)
13.706.14	Marketing Management (MP)
13.706.15	Industrial Hydraulics (MP)
13.706.16	Machine Tool Technology (MP)
13.706.17	Turbo Machines (MP)
13.706.18	Bio Materials (MP)
13.706.19	Concurrent Engineering (MP)
13.706.20	Alternate Energy Sources (MP)

13.701 PRINCIPLES OF MANAGEMENT AND DECISION MODELING (MPU)

Teaching Scheme: 2(L) - 1(T) - 0(P) **Credits**: 3

Course Objective:

The main objectives of this course are

- *To understand evolution of scientific management and principles of management in organizations.*
- *To understand different types of industrial ownerships and organizational structures.*
- *To learn the methods and techniques to effectively manage human resource in an organization.*
- *To understand various quantitative techniques in decision making.*

Module – I

Evolution of Scientific management: Principles and functions of scientific management, Levels and skills of management.

Organizational structure: Authority, responsibility and span of control -system concept of management - Line and staff, project and matrix organization.

Formation of companies: Proprietary Partnership and joint stock companies – private limited, public limited companies, cooperative organizations and Government organizations.

Module – II

Selection of site- factors to be considered – Economic vs. social significance of location.

Plant layout- different types- process, product, fixed position and group technology layout. Personnel management - objectives and function-recruitment, selection, orientation and training of workers Industrial safety and health - Labour welfare –Industrial psychology.

Module – III

Sales management: Objectives and function - Marketing: Concepts, Market segmentation-marketing mix-product life cycle. Forecasting of demand – different - methods (simple problems).

Decision making-Types of decisions-The decision making process - decision tree - linear programming and its application in management, transportation and assignment problems.

Module – IV

Game theory and its applications - Queuing theory: Single server models- network theory – CPM – crashing of networks, PERT – probability of completion.-Simulation modeling (Basic concepts only), Advantages and disadvantages of simulation.

References:

1. Chabra T. N., *Principles & Practice of Management*, Dhanpat Rai Pub.
2. Mahajan M*., Industrial Engineering & Production Management*, Dhanpat Rai Pub.
3. Barry Render and, Ralph M Stir Jr., *Quantitative Analysis for Management*, Prentice Hall India, New Delhi.
4. Hillier and Lieberman, *Fundamentals of Operations Research*, Kluwer Academic Pub.
5. Basu C. R., *Business Organization & Management*, Tata McGraw Hill.
6. Tripathi and Reddy, *Principles of Management*, Tata McGraw Hill.
7. Fraidoon Mazda, *Engineering Management*, Pearson Edn. Asia.
8. Bernaud W. Taylor III, *Introduction to Management Science*, Pearson Edn, Asia.
9. Koontz and Weihrich, *Essentials of Management*, Tata McGraw Hill.
10. Meenakshi Gupta, *Principles of Management,* PHI Learning, New Delhi.
11. Telsang M., Industrial Engineering and Production Management, Dhanapat Rai Pub.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

At the end of the course the students will be able to have an understanding of various tools and techniques for the efficient and effective use of resources in an organization and application of these techniques for better management of the organization.

13.702 MECHATRONICS (MPSU)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

The main objectives of this course are

- *To understand the features of various sensors used in CNC machines and robots.*
- *To study the fabrication and functioning of MEMS pressure and inertial sensors.*
- *To develop hydraulic/pneumatic circuit and PLC program for simple applications.*

Module – I

Introduction to Mechatronics: Structure of Mechatronics system. Sensors - Characteristics - Temperature, flow, pressure sensors. Displacement, position and proximity sensing by magnetic, optical, ultrasonic, inductive, capacitive and eddy current methods. Encoders: incremental and absolute, gray coded encoder. Resolvers and synchros. Piezoelectric sensors. Acoustic Emission sensors. Principle and types of vibration sensors.

Module – II

Actuators: Hydraulic and Pneumatic actuators - Directional control valves, pressure control valves, process control valves. Rotary actuators. Development of simple hydraulic and pneumatic circuits using standard Symbols.

Micro Electro Mechanical Systems (MEMS): Fabrication: Deposition, Lithography, Micromachining methods for MEMS, Deep Reactive Ion Etching (DRIE) and LIGA processes. Principle, fabrication and working of MEMS based pressure sensor, accelerometer and gyroscope.

Module – III

Mechatronics in Computer Numerical Control (CNC) machines: Design of modern CNC machines - Mechatronics elements - Machine structure: guide ways, drives. Bearings: anti-friction bearings, hydrostatic bearing and hydrodynamic bearing. Re-circulating ball screws, pre-loading methods. Re-circulating roller screws. Typical elements of open and closed loop control systems. Adaptive controllers for machine tools. Programmable Logic Controllers (PLC) –Basic structure, input/ output processing. Programming: Timers, Internal Relays, Counters and Shift registers. Development of simple ladder programs for specific purposes.

System modeling - Mathematical models and basic building blocks of general mechanical, electrical, fluid and thermal systems.

Module – IV

Mechatronics in Robotics-Electrical drives: DC, AC, brushless, servo and stepper motors. Harmonic drive. Force and tactile sensors. Range finders: ultrasonic and light based range

finders. Robotic vision system - Image acquisition: Vidicon, charge coupled device (CCD) and charge injection device (CID) cameras. Image processing techniques: histogram processing: sliding, stretching, equalization and thresholding.

Case studies of Mechatronics systems: Automatic camera, bar code reader, pick and place robot, automatic car park barrier system, automobile engine management system.

References

1. Bolton W., *Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering*, Person Education Limited, New Delhi, 2007
2. HMT, *Mechatronics*, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2004.
3. Ramachandran K. P., G. K. Vijayaraghavan, M. S. Balasundaram, *Mechatronics: Integrated Mechanical Electronic Systems*, Wiley India Pvt. Ltd., New Delhi, 2008.
4. David G. Aldatore, Michael B. Histand, *Introduction to Mechatronics and Measurement Systems*, McGraw-Hill Inc., USA, 2003.
5. Vijay K. Varadan, K. J. Vinoy, S. Gopalakrishnan, *Smart Material Systems and MEMS: Design and Development Methodologies*, John Wiley & Sons Ltd., England, 2006.
6. Saeed B. Niku, *Introduction to Robotics: Analysis, Systems*, Applications, Person Education, Inc., New Delhi, 2006.
7. Gordon M. Mair, *Industrial Robotics*, Prentice Hall International, UK, 1998.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of the course students will be able:

- *To discuss mechanical systems used in mechatronics*
- *To integrate mechanical, electronics, control and computer engineering in the design of mechatronics systems.*

13.703 GAS DYNAMICS (M)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

- *To familiarize with behavior of compressible gas flow.*
- *To understand the difference between subsonic and supersonic flow.*
- *To familiarize with high speed test facilities.*

Module – I

Introduction to Compressible Flow- Concept of continuum-system and control volume approach- conservation of mass, momentum and energy- stagnation state- compressibility- Entropy relations.

Wave propagation- Acoustic velocity-Mach number-effect of Mach number on compressibility- Pressure coefficient-physical difference between incompressible, subsonic, sonic and supersonic flows- Mach cone-Sonic boom-Reference velocities- Impulse function-adiabatic energy equation-representation of various flow regimes on steady flow adiabatic ellipse.

Module – II

One dimensional steady isentropic flow- Adiabatic and isentropic flow of a perfect gas- basic equations- Area-Velocity relation using 1D approximation-nozzle and diffuser-mass flow rate-chocking in isentropic flow-flow coefficients and efficiency of nozzle and diffuser-working tables-charts and tables for isentropic flow- operation of nozzle under varying pressure ratios –over expansion and under expansion in nozzles.

Irreversible discontinuity in supersonic flow- one dimensional shock wave- stationary normal shock- governing equations- Prandtl- Meyer relations- Shock strength- Rankine-Hugoniot Relation- Normal Shock on T-S diagram- working formula- curves and tables-Oblique shock waves - supersonic flow over compression and expansion corners (basic idea only).

Module – III

Flow in a constant area duct with friction (Fanno Flow) – Governing Equations- Fanno line on h-s and P-v diagram- Fanno relation for a perfect gas- Chocking due to friction- working tables for Fanno flow- Isothermal flow(elementary treatment only)

Flow through constant area duct with heat transfer (Rayleigh Flow)-Governing equations-Rayleigh line on h-s and P-v diagram-Rayleigh relation for perfect gas- maximum possible heat addition-location of maximum enthalpy point- thermal chocking- working tables for Rayleigh flow.

Module – IV

Compressible flow field visualization and measurement- Shadowgraph-Schlieren technique-interferometer- subsonic compressible flow field -measurement (Pressure, Velocity and

Temperature) – compressibility - correction factor- hot wire anemometer- supersonic flow measurement- Shock tube-Rayleigh Pitot tube- wedge probe- stagnation temperature probe- temperature recovery factor –Kiel probe - Wind tunnels – closed and open type- sub sonic – supersonic wind tunnels – shock tube.

Data book/Gas tables:

1. Yahya S. M., *Gas Tables***,** New Age International.
2. Balachandran P., *Gas Tables*, Prentice-Hall of India Pvt. Limited.

References:

1. Shapiro, *Dynamics and Thermodynamics of Compressible Flow* -I., John Wiley & Sons.
2. Yahya S. M., *Fundamentals of Compressible Flow with Aircraft and Rocket Propulsion*, New Age International Publishers.
3. Balachandran P., *Fundamentals of Compressible Fluid Dynamics*, PHI Learning.
4. Rathakrishnan E., Gas Dynamics, PHI Learning.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

***Note:** Use of approved gas tables is permitted during examination.*

Course Outcome:

At the end of the course students will be able

- *To formulate and solve problems in one -dimensional steady compressible flow including: isentropic nozzle flow, constant area flow with friction (Fanno flow) and constant area flow with heat transfer (Rayliegh flow).*
- *To derive the conditions for the change in pressure, density and temperature for flow through a normal shock.*
- *To determine the strength of oblique shock waves on wedge shaped bodies and concave corners.*
- *To discuss the various measuring instruments used in compressible flow.*

13.704 REFRIGERATION AND AIR CONDITIONING (M)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objective:

The main objective of this course is to provide an insight into how thermodynamic principles are applied in the air conditioning and refrigeration.

Module – I

Introduction – Brief history and applications of refrigeration.. Thermodynamics of refrigeration- reversed Carnot cycle- heat pump and refrigeration machines, Limitations of reversed Carnot cycle. Unit of refrigeration- Air refrigeration systems- Reversed Joule cycle, Air craft refrigeration systems, simple bootstrap- Regenerative and reduced ambient system- Vortex tube refrigeration-Very low temperature refrigeration systems (concept only). Adiabatic demagnetization of paramagnetic salts.

Module – II

Vapour compression systems-simple cycle - representation on T- s and P- hDiagrams. COP-Effect of operating parameters on COP – methods of improving COP of simple cycle- super-heating , under cooling, Liquid suction heat exchangeractual, cycle. Multi pressure systems - multi compression and multi evaporator, systems. Inter cooling - flash inter cooling and flash gas removal- Different combinations of evaporator and compressor for different applications, Cascade system. Refrigerants and their properties-Eco-friendly Refrigerants, mixed refrigerants, selection of refrigerants for different applications.

Module – III

Vapour absorption systems - Ammonia – water system - simple system- drawbacks-Lithium Bromide water system- Electrolux- comparison with vapour compression system- steam jet refrigeration. Application of refrigeration- domestic refrigerators- water coolers- ice plants. Cold storages- food preservation methods- plate freezing , quick-freezing. Refrigeration system components- Compressors, condensers, expansion devices, evaporators. Cooling towers- Different types and their application fields- Refrigerant leakage and detection – charging of refrigerant – system controls.

Module – IV

Air conditioning – meaning and utility, comfort and industrial air conditioning. Psychometric properties- saturated and unsaturated air, dry, wet and dew point temperature – humidity, specific humidity, absolute humidity, relative humidity and degree of saturation-

thermodynamic equations - enthalpy of moisture - adiabatic saturation process psychrometers. Thermodynamic wet bulb temperature, Psychrometric chart- Psychrometric processes- adiabatic mixing- sensible heating and cooling- humidifying and dehumidifying, air washer – bypass factor- sensible heat factor-RSHF and GSHF line- Design condition- Apparent dew point temperature – Choice of supply condition, state and mass rate of dehumidified air quantity – Fresh air supplied –air refrigeration. Comfort air conditioning- factors affecting human comfort. Effective temperature – comfort chart. Summer air conditioning- factors affecting-cooling load estimation.

Air conditioning systems- room air conditioner- split system-packaged system-all air system-chilled water system. Winter air conditioning – factors affecting heating system, humidifiers. Year round air conditioning AC system controls-thermostat and humidistat. Air distribution systems- duct system and design- Air conditioning of restaurants, hospitals, retail outlets, computer center, cinema theatre, and other place of amusement. Industrial applications of air conditioning.

References:

1. Stoecker W.F., *Refrigeration and Air-Conditioning*, McGraw-Hill Publishing Company.
2. Arora C. P., *Refrigeration and Air-Conditioning*, Tata McGraw-Hill Education.
3. Arora S. C. and Domkundwar, *Refrigeration and Air-Conditioning*, Dhanpat Rai.
4. Manohar Prasad, *Refrigeration and Air-Conditioning*, New Age International.
5. Dossat. R. J., *Principles of Refrigeration*, Pearson Education India.
6. Ballaney P. L., *Refrigeration and Air-Conditioning*, Khanna Publishers, New Delhi.
7. ASHRAE Handbook

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Note: *Use of approved charts and tables are permitted in the examination hall.*

Course Outcome:

At the end of the course the students will be able

- *To discuss the principles refrigeration of air-conditioning and basic design considerations.*
- *To apply the concepts of indoor environmental comfort.*
- *To perform Psychrometric calculations, humidity control and analysis of air-conditioning processes.*

13.705 DESIGN OF MACHINE ELEMENTS - II (M)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits:** 4

Course Objectives:

To provide basic knowledge on the design of gears, bearings, IC engine components and pressure vessels.

Module – I

Design of gears- nomenclature – spur, helical, bevel and worm gears – gear materials -tooth loads - design stresses -basic tooth stresses – stress concentration - service factor - velocity factor - bending strength of gear tooth - Lewis equation and Lewis form factor. Working stress in gear teeth - Dynamic load and wear load on gear teeth- Buckingham's equation for dynamic load - surface strength and durability - design for strength and wear, Design of spur gear, Helical gear, bevel gear and worm gear-AGMA standards.

Module – II

Bearings and Lubrication- Introduction to lubrication - types of lubrication and lubricants – viscosity – Design of journal bearings- Sommerfield Number, bearing materials. Rolling contact bearings - bearing types - Ball & roller bearings- Static and Dynamic load capacity- Equivalent dynamic load-Bearing life- Stribeck's equations, selection of bearings.

Module – III

Design of I.C engine parts-cylinder, piston, connecting rod, crankshaft and flywheel.

Module – IV

Pressure vessels, thin cylinders, Thick cylinder equation, open and closed cylinders.
Friction and power loss in pivots and collars- clutches: design of single plate, multiple plate, cone clutches and centrifugal clutch.

Design Data hand book

1. Design data Book -K. Mahadevan – C.B.S Pub.
2. P.S.G., Tech., *Machine Design Data Handbook*

References:

1. Shigley J. E., *Mechanical Engineering Design*, McGraw Hill Book Company, 2014.
2. Bhandari V. B., *Design of Machine Elements,* Tata McGraw Hill, 2010.
3. Gope P. C., *Machine Design- Fundamentals and Applications,* Prentice Hall, 2012.
4. Spotts M. F. And T. E. Shoup, *Design of Machine Elements*, Pearson Education, 2006.
5. Timoshenko S. P.and J. N. Goodier, *Theory of Elasticity*, McGraw Hill Book Co.

6. Siegel, Maleev and Hartman, *Mechanical Design of Machines*, International Book Company, 1965.
7. Phelan R. M., *Fundamentals of Mechanical Design,* Tata McGraw Hill, 1975.
8. Doughtie V. L., and A.V. Vallance, *Design of Machine Elements*, McGraw Hill, 1964.
9. Juvinall R. C. and K.M. Marshek, *Fundamentals of Machine Component Design,* John Wiley, 2011.
10. Robert L Norton. *Machine Design*, Prentice Hall India, 2013.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Five Short answer questions of 4 marks each. All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

***Note:** Use of approved data book is permitted in the examination hall.*

Course Outcome:

At the end of the course student the student will be able to approach a design problem successfully and demonstrate knowledge on the design of machine elements to withstand the loads and deformations for a given application.

13.706.1 PLANT ENGINEERING & MAINTENANCE (MPU) (Elective III)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

The main objectives of this course are

- *To gain knowledge in plant engineering and maintenance.*
- *To become familiar with maintenance management.*
- *To study the different maintenance management schemes.*

Module – I

Wear –fundamentals and analysis – Classification – Theories of wear – Wear –fundamentals Analytical treatment of wear - Effect of moisture , gas and liquids on wear –Effect of temperature – Fatigue. Wear prevention methods. Lubricants – Solid , fluid and semi fluid – Synthetic – General properties and applications – Tests and classifications – Additives-Testing of lubricants selection of lubricants-lubricating mechanisms.

Module – II

Reliability – Analysis and Concepts – Chance failure and wear out failure –Application of stochastic model for reliability studies – Reliability of series , parallel and stand –by systems – Estimation of parameters for failure distributions – Maintainability -availability.

Module – III

Replacement – Analysis of different models - Causes of deterioration and obsolescence – Sudden and gradual obsolescence. Deterioration – MAPI method –simple problems .Maintenance – types (corrective, scheduled, preventive, predictive and proactive maintenance). – Deterioration and failure analysis – planning, scheduling and controlling of maintenance work – organisation for maintenance.

Module – IV

Safety engineering, accident prevention programme, safety design concepts, fire protection-industrial noise-Legislations on safety in industry. Recent Developments in maintenance methods – RCM - CBM –DMS – TPM etc.

References

1. Miller and Blood, *Modern Maintenance Management*, D B Tarapur.
2. *Plant Engineer's Hand Book*, McGraw Hill.
3. Maynard H.B, *Industrial Engineering Hand book*, McGraw-Hill, 2001
4. Irason W. G., *Reliability Hand Book*, McGraw Hill.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of the course the students will be able

- *To discuss wear and theories of failure.*
- *To suggest maintenance schemes.*
- *To discuss safety issues and related rules.*

13.706.2 FRACTURE MECHANICS (MPU) (Elective III)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

The main objectives of this course are

- *To get knowledge in fracture phenomena in metals and non-metals.*
- *To become familiar with testing methods.*

Module – I

Introduction: Significance of fracture mechanics - Griffith energy balance approach -Irwin's modification to the Griffith theory - stress intensity approach - crack tip plasticity - fracture toughness - sub critical crack growth - influence of material behaviour - modes I, II & III - mixed mode problems Linear elastic fracture mechanics (LEFM): Elastic stress field approach - mode I elastic stress field equations - expressions for stresses and strains in the crack tip region - finite specimen width - superposition of stress intensity factors (SIF) – SIF solutions for well known problems such as centre cracked plate, single edge notched plate, and embedded elliptical cracks.

Module – II

Crack tip plasticity: Irwin plastic zone size - Dugdale approach - shape of plastic zone - state of stress in the crack tip region - influence of stress state on fracture behaviour Energy balance approach: Griffith energy balance approach - relations for practical use - determination of SIF from compliance - slow stable crack growth and R-curve concept - description of crack resistance LEFM testing: Plane strain and plane stress fracture toughness testing - determination of R-curves - effects of yield strength and specimen thickness on fracture toughness - practical use of fracture toughness and R-curve data.

Module – III

Elastic plastic fracture mechanics (EPFM): Development of EPFM - J-integral – crack opening displacement (COD) approach - COD design curve - relation between J and COD - tearing modulus concept - standard JIc test and COD test Fatigue crack growth**:** Description of fatigue crack growth using stress intensity factor - effects of stress ratio and crack tip plasticity - crack closure - prediction of fatigue crack growth under constant amplitude and variable amplitude loading - fatigue crack growth from notches - the short crack problem.

Module – IV

Sustained load fracture: Time-to-failure (TTF) tests - crack growth rate testing - experimental problems - method of predicting failure of a structural component - practical significance of

sustained load fracture testing Practical problems: Through cracks emanating from holes - corner cracks at holes - cracks approaching holes - fracture toughness of weldments - service failure analysis - applications in pressure vessels - pipelines and stiffened sheet structures.

References

1. Ewalds H. L. and R. J. H. Wanhill, *Fracture Mechanics*, Edward Arnold Edition.
2. Broek D., *Elementary Engineering Fracture Mechanics*, Sijthoff & Noordhoff Int. Pub.
3. Kare Hellan, *Introduction to Fracture Mechanics*, McGraw Hill Book Company.
4. Prashant Kumar, *Elements of Fracture Mechanics*, Wheeler Publishing.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of the course students will be able

- *To predict material failure for any combination of applied stresses.*
- *To estimate failure conditions of a structure.*
- *To predict the likelihood of failure of a structure containing a defect.*

13.706.3 ENTREPRENEURSHIP DEVELOPMENT (MPU) (Elective III)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

The main objectives of this course are

- *To gain knowledge entrepreneurship process.*
- *To become familiar industrial policies.*
- *To know process strategies for starting a venture.*

Module – I

Entrepreneurial perspectives - understanding of entrepreneurship process - entrepreneurial decision process - entrepreneurship and economic development - characteristics of entrepreneur - entrepreneurial competencies- managerial functions for enterprise.

Module – II

Process of business opportunity identification and evaluation - industrial policy - environment - market survey and market assessment - project report preparation - study of feasibility and viability of a project - assessment of risk in the industry.

Module – III

Process and strategies for starting a venture - stages of small business growth, Entrepreneurship in international environment - achievement motivation – time management - creativity and innovation structure of the enterprise - planning, implementation and growth.

Module – IV

Technology acquisition for small units - formalities to be completed for setting up a small scale unit - forms of organizations for small scale units – financing of project and working capital - venture capital and other equity assistance available - break even analysis and economic ratios technology transfer and business incubation.

References

1. Harold Koontz and Heinz Weihrich, *Essentials of Management*, McGraw Hill
2. Hirich R. D. and M. P. Peters Irwin, Entrepreneurship, McGraw Hill
3. Rao T. V., M. V. Deshpande, Prayag Metha and M. S. Nadakarni, *Developing Entrepreneurship- A Hand Book*, Learning Systems.
4. Donald Kurado and Richard M. Hodgelts, *Entrepreneurship A Contemporary Approach*, The Dryden Press.
5. Patel V. G., *Seven Business Crisis*, Tata McGraw Hill.

6. Timmons J.A., *New Venture Creation-Entrepreneurship for 21st Century*, McGraw Hill.
7. Patel J. B. and S. S. Noid, *A Manual on Business Opportunity Identification, Selections*, EDII.
8. Pandey G. W., *A Complete Guide to Successful Entrepreneurship*, Vikas Publishing.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of the course students will be able

- *To discuss the strategies for starting a venture.*
- *To discuss industrial policies.*

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13.706.4 FINITE ELEMENT METHODS (MPU) (Elective III)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

The main objectives of this course are

- *To understand the fundamental concepts of the theory of the finite element method.*
- *To solve simple structural and heat transfer problems using finite element methods.*

Module – I

Introduction, historical background, applications, advantages, finite element softwares. Theory of elasticity - stress and equilibrium, stress-strain relationship, strain-displacement relationship, plane stress, plane strain and axi-symmetric approximation. Temperature effects. Potential energy and equilibrium, Principle of minimum potential energy. Discrete and Continuous systems, Rayleigh-Ritz method, Galerkin method. Solution of Algebraic equations, Banded and skyline solutions. Global, Local and Natural coordinates in 1, 2 and 3 dimensions - Area coordinates.

Module – II

Numerical Integration using Gauss quadrature. Finite element modeling - types of elements, Discretization, Mesh generation and numbering. Shape functions - types and properties. Iso parametric formulation. Largrangean and Serendipity elements. One dimensional elasticity problems - discretisation of domain into elements - generalised coordinates approach - derivation of elements equations - assembly of element equations - transformation matrices - global equations, load vector.

Module – III

Properties of stiffness matrices, imposition of Boundary conditions - penalty and elimination approach, multi-point constraints. Finite element formulation of plane trusses, beams and beams on elastic supports. Finite element formulation of 2D problems using constant strain triangle element and isoparametric quadrilateral element. Axi-symmetric solids subjected to axi-symmetric loading.

Module – IV

Features of 3D problems in stress analysis. Scalar field problems - one dimensional heat conduction through composite walls and fins, potential flow. Dynamic problems- Hamilton's principle, Mass matrices, lumped and consistent formulations.

References

1. Tirupathy. R. Chandrapatla and Ashok D. Belagundu, *Introduction to Finite Elements in Engineering*, Pearson.

2. Krishnamoorthy C. S., *Finite Element Analysis: Theory and Programming*, Tata McGraw Hill.
3. Reddy J. N., *Introduction to the Finite Element Method*, McGraw Hill.
4. Zienkieviz O. C and R.L.Taylor, *Finite Element Methods*, Butterworth Heinemann.
5. Cook R. D., *Concepts and Applications of Finite Element Analysis*, Wiley.
6. Rao S. S., *The Finite Element Method in Engineering*, Butterworth Heinemann.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of the course students will be able

- *To identify mathematical models for solution of common engineering problems.*
- *To formulate simple problems into finite elements.*
- *To solve simple structural and heat transfer problems using finite element method.*

13.706.5 METAL FORMING (MPU) (Elective III)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

The main objectives of this course are

- *To gain deeper knowledge on metal forming under different conditions and in various processes.*
- *To do analyses of rolling and forging processes.*

Module – I

Basic laws and theories of plasticity - stress space - yield criterion of metals -Von-Mises yield criterion - Tresca criterion - representation of the criteria in stress space - yield surface - subsequent yield surfaces – experimental investigations of the yield criteria - basic considerations of plasticity theory - simple models of material behaviour - Levy-Mises stress strain relations - Prandtl-Reuss stress strain relations - experimental verification.

Module – II

Plastic potential theory - plastic work - maximum work hypothesis – stability postulates - isotropic and kinematic hardening - plastic flow - temperature and strain rate effects in plastic flow Processes - drawing and extrusion - process classification - lubrication - temperature effects - analysis of the processes of drawing and extrusion of wire and strip through friction less dies and dies with friction - production of seamless pipe and tubes - analysis - residual stresses in rods - wires - tubes, deep drawing.

Module – III

Classification of rolling processes - hot rolling - cold rolling - rolling of bars and shapes - analysis of rolling process in conditions of plane strain. Classification of forging process - open die forging - closed die forging - analysis of forging process in conditions of plane stain - forging allowances and tolerances - sheet metal forming, shearing, blanking, bending and stretch forming.

Module – IV

Slip line field theory - incompressible two-dimensional flow - slip lines - equilibrium equations referred to slip lines - Henkeys theorem - hodographs - simple slip line field analysis in extrusion - compression of block between parallel plates - strip load on semi-infinite body - lower and upper bound theorems with proofs and applications.

References

1. Oscar Hoffman and George Sachs, *Introduction to Theory of Plasticity for Engineers*, McGraw Hill.

2. Dieter G. E., *Mechanical Metallurgy*, McGraw Hill.
3. Johnson W. and Mellor P.B., Plasticity for Mechanical Engineers, D Van Nostrand Co. Ltd.
4. Chen W.F. & Han D.J., Plasticity for Structural Engineers, Springer Verlag.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of this course the students will be able

- *To identify suitable process for a particular application.*
- *To discuss various processes such as rolling, forging etc. and also the theories*

13.706.6 NON-CONVENTIONAL MACHINING TECHNIQUES (MPU) (Elective III)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

The main objective of this course is to introduce the various non traditional machining techniques.

Module – I

The need of the process classification - Energies employed in the processes- EDM, EC, USM, LBM, PAM, AJM, WJM etc. Electrical Discharge Machining Process, operating principles-Breakdown mechanism-Dielectric fluid-Electrode material-Tool wear – Power generator circuits- Process parameters - Metal removal rate - wire out EDM – Recent Developments in EDM. Applications.

Module – II

Electro Chemical Machining Process-principles-Equipment-Analysis of metal removal-tool material-Insulation-Process parameters-ECH,ECG etc. Applications Electron Beam Machining Process, Principle-gun construction - Types of gun - Vacuum and non-vacuum technique Applications Laser Beam Machining Process, principles, pumping processes, emission types-beam control. Applications.

Module – III

Ultrasonic Machining Process-working principles-types of transducers concentrators- nodal point clamping-feed mechanism-metal removal rate- Process parameters. Applications.

Module – IV

Abrasive Jet Machining Processes-Principle-Equipment-Metal removal rate process parameters. Applications.

Water Jet Machining Process- Introduction WJM Machine, Process Characteristics Process Performance, Applications.

References

1. Mishra P. K., *Non Conventional Machining*, The Institution of Engineers (India) Text Books: Series, 1997.
2. Sharma P. C., *A Text Books of Production Engineering*, 1995.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of this course the students will be able

- *To identify suitable process for a particular application.*
- *To discuss the various non traditional machining techniques.*

13.706.7 EXPERIMENTAL METHODS IN ENGINEERING (MPU) (Elective III)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

The main objective of this course is to introduce the various measuring instruments.

Module – I

Pressure measurement devices – U tube manometer – Well type manometer– Different types of manometers. Elastic pressure transducers – Bourdon tubes – Diaphragms – Bellows. Capacitance pressure gauge. Diaphragm type strain gauge pressure pickup. LVDT diaphragm differential pressure gauge. High-pressure measurement – very high-pressure transducer. Low-pressure measurement – Mc Leod-gauge pirani thermal conductivity gauge – Knudsen gauge – lonization gauge. Dead weight tester for static calibration of pressure gauges. Methods for flow measurement – Positive displacement methods – rotary vane flow meter – Lobed impeller flow meter. Flow obstruction methods – Venturi – flow nozzle – orifice. Practical considerations for obstruction flow meters. Recommended proportions for venturi tubes, flow nozzles and orifices. Flow measurement by drag effects – rotameter – turbine meter – vortex shedding flow meter. Hot wire and hot film anemometers. Thermal mass flow meter. Magnetic flow meter.

Module – II

Pressure probes – pitot tube – pitot static tube – Kiel probe. Yaw angle – yaw angle characteristics of various static pressure probes. Fluid factors, application factors and installation

factors of different types of flow meters. Temperature measurement by mechanical effects – mercury in glass thermometer – bimetallic strip type – fluid expansion thermometers. Temperature measurement by electrical effects – electrical resistance thermometer. Methods of correction for lead resistance – Siemens three lead arrangement – callender four lead arrangement and floating-potential arrangement. Thermostats. Temperature measurement due to thermo-electric effects – thermocouples – different types and its range – law of temperature –emf vs. temp relationships for different thermocouples – sensitivity of thermocouples – thermopile and its practical application – installation of thermocouple on a metal plate – Thin foil thermocouples for rapid transient response. Temperature measurement by radiation – optical pyrometer.

Module – III

Thermal conductivity measurement – guarded hot plate apparatus –measurement of thermal conductivity of metals. Thermal conductivity of liquids and gases – guarded hot plate apparatus – concentric cylinder method – apparatus for determination of thermal

conductivity of gases at high temperatures. Measurement of viscosity – rotating concentric cylinder apparatus – Saybolt viscometer. Gas diffusion – measurement of diffusion coefficients in gases. Convection heat transfer measurements – forced convection heat transfer coefficients in smooth tubes. Humidity

measurements. Heat flux meters. Elastic elements for force measurements – simple cantilever and thin ring elastic elements – Proving ring. Torque measurements – hollow cylinder for torque measurement – Prony brake – hydraulic dynamometer – Cradled dynamometer.

Module – IV

Strain measurements – electrical resistance strain gauges-different types – characteristics of strain gauge materials. Temperatures compensation for electrical resistance strain gauges strain gauge rosettes –bonded and unbounded resistance strain gauges. Cantilever beam used as a frequency measurement device. Principles of seismic instrument – practical considerations for seismic instruments –electrical resistance strain gauge seismic instrument – piezoelectric transducer type seismic instrument. Sound measurements – microphones – characteristics of microphones. Psychoacoustics factors – sound level meter– acoustic properties of materials – sound absorption coefficient – noise reduction coefficient. Air pollution measurement – units for pollution measurement – air pollution standards – Air sampling train.

References

1. Holman J.P., *Experimental Methods for Engineers*, McGraw-Hill.
2. Ernest O. Doebelin, *Measurement System – Application and Design*, McGraw-Hill.
3. Donald P. Eckman, *Industrial Instrumentation*, John Wiley.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of the course students will be able

- *To identify the suitable instrument for measuring transport parameters*
- *To distinguish different flow visualization methods and temperature measurements.*
- *To determine thermal conductivity of solids, liquids and gases and also radiation measurements.*

13.706.8 MECHANICAL VIBRATION & NOISE CONTROL (MPU) (Elective III)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

The main objectives of this course are

- *To apply the laws of motion to oscillating systems*
- *To examine the effects of energy-removal mechanisms; i.e. damping.*
- *To introduce modes of vibration in terms of system physical parameters.*
- *To introduce types of noise and noise control.*

Module – I

Introduction – Harmonic motion – Beat frequency – Equations of motion –Concepts of forces and equilibrium – Systems with one degree of freedom –Free and forced vibrations with undamped and damped systems (Review) Two degrees of freedom systems : Equations of motions for free and forced vibration without and with damping – Use of influence coefficients – The work and energy approach – Solutions to free , forced and damped vibrations and torsional systems – Dynamic absorbers periodic and Non periodic.

Module – II

Vibration – Fourier series representation – Unit impulse step , ramp and arbitrary excitation – Response spectrum – Analog computer set up for solving vibration problems -,Vibration measuring instruments . Solutions to Differential Equations, Laplace Transforms. Jump phenomenon – Effect of damping – Self excited Oscillations.

Module – III

Introduction to sound and vibratic wave motion – One dimensional plane waves – Characteristics impedance – Decibel seats power, density and intensity – Sound transmission through one and two intervening media. Measurement of Sound – Loud speakers and microphones – Their characteristics, Band pass filters, graphic level recorder, Narrow Band Analysers - Measurement in reverberation and Vachaic chamber –Hearing mechanism of hearing and perception of sound (Description only).

Module – IV

Types of noise : Criteria for evaluation of noise problems – Threshold of hearing – Hearing loss with age – Equal loudness contours loudness and loudness level – Perceived noise level – N.C. curves – Noise and Number index – Noise pollution level – Noise induced hearing loss – Damage risk criteria – Criteria for noise and vibration in community buildings – General principles of noise control – Use of enclosures – Wrappings – Porous materials – Design of

Auditorium – Acoustical requirements – Elimination of room acoustical defects – Articulation index – Sound reinforce systems – Design of time delays (Brief description only).

References

1. Anderson Roger A., *Fundamentals of Vibration*, Macmillan.
2. Thomsom W. T., *Theory of Vibrations*, Tata McGraw Hill.
3. Timoshenko, *Vibration problem in Engineering*, John Wiley & Sons.
4. Francis S. Tse, Ivan E. Morse and R.T. Hinkle, *Mechanical Vibrations*, Allyn and Bacon.
5. Kinslor and Frey, *Fundamentals of Acoustics*, J. Wiley & Sons.
6. Beronek .L. L., *Noise and vibration Control*, McGraw Hill.
7. Doello and Deslie L, *Environmental Acoustics*, McGraw Hill.
8. Harris C*., Hand Book on Noise control*, McGraw Hill.
9. *Hand Book of Noise Measurement* – General Radio Company .U.S.A.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of this course the students will be able

- *To appreciate the need and importance of vibration analyses in mechanical systems.*
- *To analyze the mathematical model of vibratory systems.*
- *To discuss source of noise and types of noise.*

13.706.9 FAILURE ANALYSIS (MPU) (Elective III)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

The main objectives of this course are

- *To get knowledge in failure investigation and analysis.*
- *To introduce experimental stress analysis.*
- *To get knowledge in fracture mechanics.*

Module – I

Introduction: Objectives of failure investigation, Collection of background data service history, photographic records, Selection of samples for various conditions, Preliminary examination of the failed part – visual inspection and non destructive techniques for failure investigation- Magnetic particle inspection, Liquid penetrant inspection, Eddy current inspection, ultrasonic inspection, radiography, acoustic emission inspection.

Module – II

Experimental stress Analysis Mechanical testing, limitations of tensile testing, Selection preservation and cleaning of fracture surfaces- cleaning, sectioning, opening secondary cracks Macroscopic examination of fracture surfaces, Microscopic examination of fracture surfaces – optical microscopy, scanning electron microscopy, transmission electron microscopy, Selection and preparation of metallographic sections, Examination and analysis of metallographic sections.

Module – III

Determination of fracture type- Failure mechanisms and Fractography of ductile fracture, brittle fracture, transgranular brittle fracture, Intergranular brittle fracture Fatigue fracture- Mechanisms and general features of fatigue fracture Stress corrosion cracking, Liquid metal embrittlement, Hydrogen embrittlement, Creep and stress rupture failures, ductile to brittle fracture transition Chemical analysis- Analysis of bulk materials, analysis of surfaces and deposits, spot tests.

Module – IV

Applications of fracture mechanics: Fracture mechanics concepts- Linear elastic fracture mechanics, Elastic-Plastic fracture mechanics (basic concepts), plane stress and plane strain, Fatigue crack growth rate their use in failure analysis, fracture toughness testing- Plane strain fracture toughness test, COD test, Simulated service testing, Analyzing the evidences

formulating conclusions and report writing, Case studies of failures: failures of shafts, failures of heat exchangers.

References

1. *ASM Handbook Volume 11: Failure analysis and Prevention.*
2. Prashant Kumar, *Fracture Mechanics*, Wheeler Publishing.
3. Dieter, *Mechanical Metallurgy*, McGraw Hill.
4. Goodhew P. J., J. Humphreys and R. Beanland, *Electron microscopy and analysis*, Taylor and Francis, 2001.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of this course the students will be able:

- *To investigate failure using various techniques.*
- *To discuss the various tools/equipment used for investigations of failure.*
- *To discuss the various types of fracture and also application of fracture mechanics.*

13.706.10 INDUSTRIAL AUTOMATION (MPU) (Elective III)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

The main objectives of this course are

- *To introduce the automation and types of automation*
- *To gain knowledge in pneumatics*
- *To introduce robotics and automatic assembly process.*

Module – I

Introduction: Basic concept of Automation, Types of Automation, Feasibility etc. Industrial Hydraulics: Introduction, basic concepts, Hydraulic fluids, Classification and properties of hydraulic fluids, Contaminates in hydraulic system, control and cleanliness standards, Fluid power generators, i.e. Gear, Vane, Piston pumps, linear and Rotary Actuators, Direction Control Valves, types, actuation methods, pressure control valves; pressure reducing valves, pressure relief valve, Unloading valve, Sequence valve, Counterbalance valve, Flow control valves simple and pressure compensated type.

Module – II

Pneumatics: Introduction, Basic components, Source, storage and distribution, treatment of compressed air, linear and Rotary actuators, Direction control valves – types, actuation methods, pressure control valves, logic devices – twin pressure valve, shutter valve, time delay valve, Pneumatic circuit design and analysis, conventional as well as computer aided design.

Module – III

Robotics: Basic concepts, classification based on Geometry, programming, drives, work volume of robots world and joint coordinates various joints, DOF, end effectors – Types and uses, Sensors in Robots, programming – Teach pendant and Computer programming, Introduction to forward and inverse kinematics, Applications of Robots.

Module – IV

Automatic Assembly System: Development of Automatic Assembly process, Transfer devices – continuous, Intermittent, synchronous and asynchronous, Vibratory feeders – Mechanics, effect of frequency, acceleration, track angle, friction, load sensitivity, orientation of parts – active and passive devices, Mechanical feeders – computation and operational details, feed tracks, Escapement devices. Product design for high-speed automatic assembly examples of design modifications.

References

1. Anthony Esposito, *Fluid Power with Application*, 5/e, Pearson Education, 2003.
2. Majumdar S. R., *Oil Hydraulic System*, Tata McGraw Hill, 2001.
3. Bolton W, Mechatronics, 2nd Edition, Pearson Education, New Delhi, 1999.
4. Necsulelscu Dan, *Mechatronics*, Pearson Education, New Delhi, 2002.
5. Geoffrey Boothroyd, *Assembly Automation and Product Design*, Marcel Dekker Inc, 1991.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of the course students will be able

- *To discuss automation and various components used for automation*
- *To discuss robotics and applications of robots*
- *To implement automatic assembly system*

13.706.11 ADVANCED THERMODYNAMICS (MP) (Elective III)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

The main objectives of this course are

- *To introduce thermodynamics of reactive mixtures and chemical equilibrium.*
- *To gain knowledge in statistical thermodynamics.*

Module – I

Review of the fundamentals of classical thermodynamics – Multi phase and multi component systems – Free energy functions – Applications of free energy functions to phase changes – Clausius – Clayperon equations – Binary systems containing liquid and solid phases. Thermodynamics of reactive mixtures – Bond energy, heat of formation, heat of reaction – Adiabatic flame temperature entropy changes for reacting mixtures.

Module – II

Chemical equilibrium – Equilibrium criteria – Evaluation of equilibrium constants and equilibrium composition – Simple numerical solutions.
Statistical thermodynamics – Fundamentals of statistical inference – Probability and frequency Stirling's approximation, Expected value , variance , elements of quantum statistics and quantum mechanics – The Schrodinger waves equation – Heisenberg uncertainty principle – Phase space – Quantum energy states.

Module – III

Mean free path of molecules – Distribution of mean free path – Maxwell - Boltzmann law and velocity distribution – Maxwell's distribution functions, Evaluation of distribution – Constants – Principle of equipartition of energy – Degree of freedom – Viscosity, Specific heat and thermal conductivity.

Module – IV

Bose – Einstein, Fermi – Dirac and Maxwell – Boltzmann statistics – Partition function and its relation to microscopic properties of an ideal gas – Translational , rotational and vibrational partition functions – Thermodynamic probability and entropy thermodynamic properties of perfect diatomic gases.

References

1. Holman J. P., Thermodynamics, McGraw-Hill.
2. Van Wylen G. J. and, R. E. Sonntag, *Fundamentals of Classical Thermodynamics*, Wiley.

3. Lay J.E., *Thermodynamics*, Isaac Pitman.
4. Myron Tribus, *Thermostatics and Thermodynamics*, Van Nostrand.
5. Kenneth Wark and Donald E. Richards, *Thermodynamics*, McGraw-Hill.
6. Warren Giodt, *Thermophysics*, Van Nostrand Reinhold Co, 1971.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of the course students will be able

- *To apply the knowledge of thermo chemistry in combustion problems.*
- *To use the knowledge in statistical thermodynamics and quantum mechanics.*
- *To apply statistical thermodynamics to calculate properties such as viscosity, specific heat etc.*

13.706.12 INDUSTRIAL HEAT TRANSFER (MP) (Elective III)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

The main objectives of this course are

- *To enhance the knowledge in heat transfer.*
- *To apply the knowledge about heat transfer in equipment used in industries.*

Module – I

One-dimensional steady state heat conduction with uniform internal heat generation. Plane wall with heat sources, cylinder with heat sources. Transient and periodic conduction (One-dimensional). Lumped heat capacity system. Simple analytical methods. Use of Heisler charts. Principles of Convection – Viscous flow, different hydrodynamic boundary layer flow regimes and flat plates – Laminar boundary layer on a flat plate – Momentum equation of the laminar boundary layer with constant properties – Internal Momentum analysis of laminar boundary layer.

Module – II

Energy Equations –Significance of Prandtl Number . Flat plate heat transfer – Conduction by integral methods (Simultaneous development of hydrodynamic and thermal boundary layer only) Emission and absorption of radiation by an absorbing medium. Determination of mean beam length – Particles in combustion products – Large particles, small particles, gases in combustion products – Effect of an absorbing medium on the radiative heat transfer within an enclosures – Exchange areas for absorbing media.

Module – III

Furnaces – Furnace geometry – Variation of temperature with time – Variation of temperature within the furnace – Representation of real gases – Heat transfer between real surfaces. Boiling heat transfer, forced convection boiling curve saturated forced convective boiling in a round tube. The two phase forced convection and nucleate boiling regions. Critical heat flow in forced convective flow –Elementary concepts.

Module – IV

The basic processes of condensation – Liquid formation, nucleation of drops at solid surfaces, droplet growth – Film condensation on a vertical flat plate - Nusselt equation for a laminar film – Improvements to the original Nusselt theory – The influence of turbulence – Condensation of horizontal tubes – Condensation within a vertical tube - Drop wise

condensation. Elementary concepts of Heat transfer in magneto fluid dynamic (Transpiration cooling, low density heat transfer and ablation) (Description only).

References

1. Holman J. P., *Heat Transfer*, McGraw Hill.
2. John G. Gollier, *Convective Boiling and Condensation*, McGraw Hill.
3. Gray W. A., R. Müller and D. W. Hopkins, *Engineering Calculations in Relative Heat Transfer*, Elsevier, 1974.
4. Hepking D. N. (Ed.), *International Series on Material Science and Technology*, Vol .13.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of the course students will be able

- *To discuss the heat transfer processes in industrial heat transfer equipment.*
- *To do thermal design of heat transfer equipment.*

13.706.13 COMPUTER GRAPHICS (MP) (Elective III)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

The main objectives of this course are

- *To introduce algorithms used to generate simple objects and transformations.*
- *To introduce Mathematical formulation on Surface description and generation.*

Module – I

Introduction to computer Graphics, Description of graphic devices – Graphic standards. Colour graphic display techniques. Graphic primitives- Circle generation algorithms – text generation. Polygons, Polygon filling.

Module – II

Transformation: Simple problems on 3D transformations and applications, Viewing transformations, Windowing, Clipping, Cohen-Sutherland outcode algorithm, Sutherland-Hodgman Algorithm, Clipping of polygons.

Module – III

Projections - Perspective geometry – Orthographic and Oblique projections –perspective transformations. Mathematical formulations on: Plane curves – Non parametric curves – space curves – Representation of space curves – cubic spline – Bezier curves B- Spline curves, Fractals, NURBS etc.

Module – IV

Mathematical formulation on Surface description and generation- Surface of revolution – Sweep surfaces, quadric surfaces, Solid modeling techniques etc. Hidden line and hidden surfaces, Z-Buffer algorithm, Scan Line algorithm for curved surfaces.

References

1. David F. Rogers and J. H. Adams, *Mathematical Elements of Computer Graphics*, 2/e, McGraw Hill International Editions.
2. Donald Hearn and M. Pauline Baker, Computer Graphics, 2/e, Prentice Hall of India.
3. Steven Harrington, *Computer Graphics*, 2/e, McGraw Hill.
4. Vera B. Anand, *Computer Graphics and 3D Modelling for Engineers*, Wiley, 1993.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of the course students will be able

- *To write algorithms for creation of simple primitives and transformations.*
- *To carry out formulation on surface description and generation.*

13.706.14 MARKETING MANAGEMENT (MP) (Elective III)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

The main objectives of this course are

- *To introduce the concept of market and marketing.*
- *To give idea about launching a new product.*
- *To introduce the various marketing strategies.*

Module – I

Introduction to marketing - concept of market and marketing – marketing environment - controllable factors - factors directed by top management - factors directed by marketing - uncontrollable factors - demography, economic conditions, competition, social and Marketing planning - marketing planning process - Boston consultancy group model - marketing mix - marketing mix variables.

Module – II

Developing, testing and launching of new products .Market segmentation and market targeting - introduction to segmentation - targeting and product positioning. Marketing research - need and scope - marketing research process – research objectives, developing research plan, collecting information, analysis, and findings - consumer behaviour - factors influencing consumer behaviour -perceived risks.

Module – III

Product life cycle - marketing strategies for different stages of product life cycle, Marketing communication - marketing mix variables - steps in developing effective communication - identification of target audience - determination of communication objectives.

Module – IV

Designing the message - selecting the communication channels - promotion mix evaluation - advertising and sales promotion - factors in advertising - sales promotion tools. New trends in marketing- Brand management - significance of branding to consumers and firms.

References

1. Kotler P, Marketing *Management: Analysis, Planning, Implementation and Control,* Prentice Hall of India.
2. Ramaswamy V. S. and S. Namkumari, Marketing *Management: Planning, Implementation and Control*, Macmillan India Limited.

3. Chabra T. N. and S. K. Grover, *Marketing Management*, Dhanapat Rai and Co.
4. Stanton W. J., M. J. Etzel and B. J.Walker, *Fundamentals of Marketing*, McGraw Hill.
5. Majumdar R., *Marketing Research*, *Text, Applications and Case Studies*, New Age International (P) Limited Publishers.
6. Robert, *Marketing Research*, Prentice Hall of India.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of the course students will be able

- *To state the role and functions of marketing within a range of organizations.*
- *To describe key marketing concepts, theories and techniques for analyzing a variety of marketing situations.*
- *To identify and demonstrate the dynamic nature of the environment in which marketing decisions are taken*
- *To synthesize ideas into a marketing plan.*

13.706.15 INDUSTRIAL HYDRAULICS (MP) (Elective III)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

The main objectives of this course are

- *To introduce various fluid power systems.*
- *To get knowledge on fluid power circuits.*

Module – I

Introduction to fluid power – Hydraulics and Pneumatics systems – Fluid power systems – Fundamentals of fluid mechanics – Measurement of physical parameters – Hydraulic symbols. Fluid power pumps and motors – Types of pumps – characteristics.

Module – II

Hydraulic cylinders and rams – Fluid power pumping systems and components. Pressure accumulators – Functions – Fluid reservoirs – Filter in hydraulic circuits. Loading and replacement of filter elements – Materials for filters.

Module – III

Hydraulic Actuators (i) Linear and Rotary. (ii) Hydraulic motors - Types- Vane, Gear, Piston types, radial piston. (iii) Methods of control of acceleration, deceleration. (iv) Types of cylinders and mountings. (v) Calculation of piston velocity, thrust under static and dynamic applications, considering friction, inertia loads. (vi) Design considerations for cylinders. Cushioning of cylinders. Fluid temperature control – Fluid pressure control –control valves – Sequence -valve – Counterbalance valve-unloading valve – Friction control valve – Servo systems.

Module – IV

Simple reciprocating, Regenerative, Speed control (Meter in, Meter out and bleed off), Sequencing, Synchronization, transverse and feed, circuit for riveting machine, automatic reciprocating, fail safe circuit, counter balance circuit, actuator locking, circuit for hydraulic press, unloading circuit (Numerical treatment), motor breaking circuit.

References

1. Pippenger J. J. and Tyler Gregory Hicks, *Industrial Hydraulics*, McGraw Hill.
2. Pinches, *Industrial Fluid Power*, Prentice Hall.
3. Pease D. A., *Basic Fluid Power*, Prentice Hall.
4. Bansal R. K., *Fluid Mechanics*, Laxmi Publication (P) Ltd.

5. Lall B., *Oil Hydraulics*, International Literature Association.
6. Yeaple, *Fluid Power Design Handbook*.
7. Andrew A. Parr, *Hydraulics and Pneumatics*, Elsevier Science and Technology Books.
8. ISO - 1219, *Fluid Systems and components, Graphic Symbols*
9. Michael J. Prinches and J. G. Ashby, *Power Hydraulics*, Prentice Hall.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of the course students will be able

- *To discuss the various components used in fluid power systems.*
- *To select the suitable system for a particular application.*
- *To discuss the various fluid circuits used in hydraulic systems.*

13.706.16 MACHINE TOOL TECHNOLOGY (MP) (Elective III)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

The main objectives of this course are

- *To gain knowledge in accuracy, surface finish and tolerance.*
- *To study various drives used in machine tools.*
- *To study erection and testing of machine tools.*

Module – I

Principal requirements and specifications – Requirements regarding quality of performance (Accuracy and surface finish) – Productivity (Role of material renewal) –Economy and efficiency of machine tools. Design aspects – Kinematic principles in machine tools with respect to the basic elements and their design – tool , column , frame , slides , guide ways, shafts , spindles , bearings, clutches, rigidity of machine tools structures – Sources, effects and elimination of vibration.

Module – II

Machine tools drives and their kinematics – Electrical, Mechanical, Hydraulic and combination systems - Design of a stepped gear box. Hydraulic power, Transmission systems used in machine tools and their various elements – A few common hydraulic circuits used to effect movement of tools slide and work tables.

Module – III

Miscellaneous – Copying devices – Automates of various kinds, feasibility determination for automation – Automatics and assembly line layout – unit heads and transfer machines - Vibration isolated tool holders – Friction and lubrication in machine tools. Erection and testing of machine tools – Location and layout – Foundations vibration – Isolation – Erection process.

Module – IV

Principles of acceptance tests – Measuring equipments and methods – Direction of tolerances – Maintenance of machine tools – Test charts for different machines. Trends in the design of modern machine tools – Aims and future development - Design for improved static and dynamic performance – Fundamental aspects of numerical control – Adaptive control and hydraulic control of machine tools.

References

1. Basu S. K., *Design of Machine Tools*, Allied Publishers.

2. Koenigsberger F., *Design Principles of Metal Cutting Machine Tools*, Pergamon Press.
3. Sen G. G. and Bhattacharya, *Principles of Machine Tools*, New Central Book agency.
4. Town M.C., *The Design and Construction of Machine Tools*, Liffe Books.
5. *Machine Tools Design Course*, Central Machine tool Institute.
6. Acherkan N., *Machine Tools Design, Volume 1,2,3,4*.
7. *Tool Engineer Hand Book*, McGraw Hill.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of the course students will be able

- *To discuss the efficiency of machine tools in terms of accuracy and surface finish.*
- *To discuss the various types of drives used in machine tools.*
- *To suggest design for improved performance of machine tools.*

13.706.17 TURBOMACHINES (MP) (Elective III)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

The main objectives of this course are

- *To enable the students know the operation of turbomachines.*
- *To provide students thorough understanding of velocity triangles, turbo-machinery*
- *To introduce students to fans, turbines, pumps etc.*

Module – I

Energy transfer between fluid and rotor, classification of fluid machinery, dimensionless parameters, specific speed, applications, stage velocity triangles, work and efficiency for compressors and turbines.

Module – II

Centrifugal fans and blowers : Types, stage and design parameters, flow analysis in impeller blades, volute and diffusers, losses, characteristics curves and selection, fan drives and fan noise.

Centrifugal Compressors: Construction details, types, impeller flow losses, slip factor, diffuser analysis, losses and performance curves.

Module – III

Axial flow compressors: Stage velocity triangles, enthalpy-entropy diagrams, stage losses and efficiency, work done factor, simple stage design problems and performance characteristics.

Module – IV

Axial and radial flow turbines: Stage velocity diagrams, reaction stages, losses and coefficients blade design principles, testing and performance characteristics.

References

1. Yahya S. H., *Turbines, Compressor and Fans*, Tata McGraw Hill, 1996.
2. Bruneck, *Fans*, Pergamom Press, 1973.
3. Earl Logan, Jr, *Hand book of Turbomachinery*, Marcel Dekker Inc, 1992.
4. Dixon S. I., *Fluid Mechanics and Thermodynamics of Turbomachinery*, Pergamom, Press, 1990.
5. Shepherd, D.G., *Principles of Turbomachinery*, Macmillan, 1969.

6. Stepanff, A. J., *Blowers and Pumps*, John Wiley and Sons Inc., 1965.
7. Ganesan V., *Gas Turbines*, Tata McGraw Hill, New Delhi, 1999.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of the course students will be able

- *To solve problems on turbo-machines*
- *To demonstrate the knowledge of working, stages, performance characteristics, governing and selection of turbo-machinery.*

13.706.18 BIO MATERIALS (MP) (Elective III)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

The main objectives of this course are

- *To gain knowledge in metallic, ceramic and composite biomaterials.*
- *To introduce biomaterial characterization.*

Module – I

Metallic biomaterials: Introduction, Stainless Steels, Cobalt Chromium Alloys, Titanium Alloys, Dental Materials, Corrosion of Medical Implants, Manufacturing of Implants. Polymeric biomaterials: Polymers used as Biomaterials, Sterilisation, Surface Modification for improving bio compatibility, biodegradable polymeric materials, Tissue derived Biomaterials, Soft Tissue Replacement, Hard Tissue Replacement, Preservation Techniques.

Module – II

Ceramic and composite biomaterials: Introduction, Bio inert Bio Ceramics, Biodegradable ceramics, Bioactive ceramics, deterioration of ceramics, manufacturing techniques, Biocompatibility and Application of Composite Biomaterials.

Module – III

Biomaterial application of smart materials: Introduction, Properties, Biocompatibility, Shape Memory effect, Super Elasticity, Hysteresis, Anti – Kinking, Application with examples – Orthopaedic, Dental, Surgical Instruments, Stent, Artificial Urethral Valves.

Module – IV

Biomaterial characterization and selection: Biomaterials surface analysis, Auger Electron Spectroscopy, Scanning ion mass Spectroscopy, Atomic Force Microscopy, Electron Spectroscopy for Chemical analysis. Function, Biocompatibility, Material Selection for Orthopaedic, Blood Contacting and Space Filling applications.

References

1. Joseph D. Bronzino, *The Bio Medical Engineering Handbook*, Vol. I, CRC Press, 2000.
2. Mel Schwartz, *Encyclopaedia of Smart Materials*, Vol. I, John Wiley and Sons, USA, 2002

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of the course students will be able

- *To identify the biomaterial for a particular application.*
- *To discuss manufacturing processes of biomaterials.*
- *To discuss biomaterial characterization and selection methods.*

13.706.19 CONCURRENT ENGINEERING (MP) (Elective III)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

The main objectives of this course are

- *To introduce concurrent design methodologies, artificial intelligence and manufacturing competiveness.*
- *To provide knowledge on life cycle realization.*

Module – I

Extensive definition of Concurrent Engineering (CE) - CE design methodologies - Organizing for CE - CE tool box collaborative product development. IT support - Solid modeling - Product data management - Collaborative product commerce.

Module – II

Artificial Intelligence- Expert systems - Software hardware co-design. Life-cycle design of products - opportunity for manufacturing enterprises - modality of Concurrent Engineering Design - Automated analysis idealization control - Concurrent engineering in optimal structural design - Real time constraints.

Module – III

Manufacturing competitiveness - Checking the design process - conceptual design mechanism – Qualitative physical approach - An intelligent design for manufacturing system. JIT system - low inventory - modular -Modeling and reasoning for computer based assembly planning – Design of Automated manufacturing.

Module – IV

Life cycle semi realization - design for economics - evaluation of design for manufacturing cost – concurrent mechanical design - decomposition in concurrent design - negotiation in concurrent engineering design studies - product realization taxonomy – plan for Project Management on new product development – bottleneck technology development.

References

1. Anderson M. M. and Hein L. Berlin, *Integrated Product Development*, Springer Verlog, 1987.
2. Cleetus J., *Design for Concurrent Engineering*, Concurrent Engg. Research Centre, Morgantown, WV, 1992.

3. Andrew Kusaik, *Concurrent Engineering: Automation Tools and Technology*, John Wiley and Sons Inc., 1992.
4. Prasad, *Concurrent Engineering Fundamentals: Integrated Product Development*, Prentice Hall, 1996
5. Sammy G Sinha, *Successful Implementation of Concurrent Product and Process*, Wiley, John and Sons Inc., 1998
6. Web Reference: www.tm.tue.nl/race/ce/ce95.html

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of the course students will be able

- *To use artificial intelligence in concurrent engineering*
- *To discuss the process of manufacturing competitiveness and life cycle realization.*

13.706.20 ALTERNATE ENERGY SOURCES (MP) (Elective III)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

The main objectives of this course are

- *To provide students an overview of global energy resources.*
- *To introduce students to bio-fuels, hydrogen energy and solar energy.*
- *To expose students to future energy systems and energy use scenarios with a focus on promoting the use of renewable energy resources and technologies.*

Module – I

Introduction: Need for non-conventional energy sources, energy conservation in transportation sector, alternative energy, alcohol, hydrogen, biomass, and electric energy Alcohol: Methanol and Ethanol production methods, properties of methanol and ethanol as engine fuels, use of alcohols in Sl engines. Performance of methanol and gasoline blends. Combustion characteristics of alcohols in S.1 engines, use of alcohols in Cl engines, different methods of use- Alcohol Diesel emulsions, dual fuel systems, Flex fuel Vehicles (FFV).

Module – II

Hydrogen energy: Properties of hydrogen, sources of hydrogen, production of hydrogen, electrolysis of water, thermal decomposition of water, thermo chemical production and biochemical production, storage and transportation methods, applications to engines, modifications necessary, precautions and safety for use, performance characteristics in engines, use in fuel cells.

Module – III

Gaseous fuels: Biogas production, description of biogas plant, application of biogas as a single fuel and dual fuel, performance of LPG, property & its use in Sl engines, fuel metering system, natural gas and producer gas - use in S.I. and C.1 engines. Vegetable oil: Vegetable oil properties, Production of Bio-diesel, esterification of vegetable oil, Soya bean diesel, rapeseed oil, rice bran oil etc., diesel and vegetable oil blends, and engine performance with vegetable oil.

Module – IV

Solar power: Collection and storage of solar energy, collection devices, flat plate collectors, concentrating type collectors, principle and working photovoltaic conversion, application to automobiles, Electric vehicles: Design considerations, limitations, batteries for electric

vehicles, types & capacities, driving requirements, applicability of electric cars, comparative use of fuel and energy recharging, Hybrid vehicles - types and layouts.

References

1. Garrett T. K., Automotive Fuels System, SAE INC, Warrendale, 1991.
2. David Powell and Richard P. Brennan, *The Automobile Technology and Society*, Prentice Hall.
3. Keeith Owen and Trevor Colley, *Automotive Fuels Reference Book*, SAE.
4. Tom Koppel, *Powering the Future*, SAE.
5. Richard L. Bechtold, *Alternate Fuels Guide Book*, SAE.
6. Bob Brant, *Build Your Own Electric Vehicle*, SAE.
7. SAE papers: 73802, 750121, 750118, 741008.
8. Energy Research Group- *Alternate Liquid Fuels*, Willey Eastern Ltd, New Delhi, 1990.
9. Vezgirigiu T. N., *Alternative Energy Sources*, Hemisphere.
10. Mathur and Sharma, *IC. Engines*, Dhanpat Rai and Sons.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of the course students will be able

- *To discuss global energy resources.*
- *To discuss the renewable technologies like solar, biomass, wind, hydrogen etc. to produce energy.*
- *To involve in optimizing and selecting an alternate source of energy.*

13.707 THERMAL ENGINEERING LABORATORY (M)

Teaching Scheme: 0(L) - 0(T) - 2(P) **Credits**: 2

Course Objective:

- *To introduce to the students the various heat transfer experiments.*
- *To equip the students to carry out experiments on compressor/blower.*

List of Experiments:

1. Determination of LMTD and effectiveness of parallel flow, Counter flow and cross flow heat exchangers.
2. Determination of heat transfer coefficients in forced and free convection
3. Determination of thermal conductivity of solids(composite wall)
4. Determination of thermal conductivity of powder
5. Determination of Thermal conductivity of liquids
6. Determination of emissivity of a specimen
7. Determination of Stefan Boltzman constant
8. Study and performance test on reciprocating compressor
9. Study and performance test on rotary compressor/blower
10. Study and performance test on refrigeration and air conditioning equipment
11. Calibration of Thermocouples
12. Calibration of Pressure gauge
13. Plotting velocity profile in pipe flow using Prandtl -Pitot tube.

Internal Continuous Assessment *(Maximum Marks-50)*

40% - Test

40% - Class work and Record

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

Questions based on the list of exercises prescribed.

80% - Procedure, calculations if any, working, results.

20% - Viva voce

Candidate shall submit the certified fair record for endorsement by the external examiner.

Course Outcome:

At the end of the course, students shall be able

- *To identify the experimental methods to find out heat transfer properties of materials.*
- *To evaluate the performance of air compressor and blower.*
- *To do calibration of thermometers and pressure gauges.*

13 .708 MECHANICAL ENGINEERING LABORATORY (M)

Teaching Scheme: 0(L) - 0(T) - 2(P) **Credits**: 2

Course Objective :

- *To introduce to the students metallurgical microscopes and to study microstructure of various metals.*
- *To equip the students to use various instruments.*
- *To introduce simple experiments on robotics and PLC.*

List of Experiments:

Metallurgy:

1. Study of Metallurgical Microscope and Polishing Machines
2. Microstructure study of Mild steel, Cast iron, Brass and Aluminium and heat treated steel.

Metrology:

1. Study and experiment using profile projector
2. Study of various measuring instruments like micrometers and calipers
3. Experiment to test flatness
4. Experiment to test roundness
5. Measurement of angle using sine bar
6. Experiment on Autocollimator
7. Study and Experiment on Tool Maker's microscope
8. Experiment on LVDT
9. Experiment on Acceptance sampling

CIM

1. Study and testing using Tool Dynamometer
2. Experiment on Robotics (Robot Programming)
3. Experiment on PLC

Internal Continuous Assessment *(Maximum Marks-50)*

40% - Test

40% - Class work and Record

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

Questions based on the list of experiments prescribed.

80% - Procedure, calculations if any, working, accuracy/result.

20% - Viva voce

Candidate shall submit the certified fair record for endorsement by the external examiner.

Course Outcome:

At the end of the course, the students will be able:

- *To identify the material by doing micro structural studies.*
- *To suggest the appropriate measuring instrument for a particular application.*

13 .709 PROJECT AND PROJECT SEMINAR (MNPSU)

Teaching Scheme: 0(L) - 0(T) - 2(P) **Credits**: 2

Course Objective :

- *To identify a problem for the final-year project, outline a solution, and prepare a preliminary design for the solution.*
- *To do a detailed study on the selected topic based on current journals or published papers and present seminars*
- *To improve the ability to perform as an individual as well as a team member in completing a project work.*
- *The seminar based on the project provides students adequate exposure to presentations to improve their communication skills.*

The student shall do a project (project phase 1) in the seventh semester, which shall be continued in the eight semester. He/she shall submit an interim report at the end of the seventh semester and the final project report shall be submitted at the end of the eighth semester. The student shall present two seminars in the seventh semester on the work carried out during project phase 1. The first seminar should highlight the definition of problem, novelty of the project, literature survey and work plan/ methodology. The second seminar should include preliminary results. The students may be assessed individually/ and in groups.

Internal Continuous Assessment *(Maximum Marks-100)*

40% - Assessment by the Guide

40% - Assessment by the Committee.

20% - Regularity in the class

Course Outcome:

At the end of the course, the students would have acquired the basic skills to for performing literature survey and paper presentation. This course shall provide students better communication skills and improve their leadership quality as well as the ability to work in groups, and thus aid them in building a successful career as an engineer.